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(54) Connection piece for  
 respiratory apparatus

(57) A connection piece, suitable for  
 use in a respiratory apparatus to  
 connect an inhalation line and an  
 exhalation line to a common supply  
 line to a patient, comprises a housing  
 (9) with a first port (2) for inhalation  
 gas, a second port (3) for exhalation

gas and a third port (4) through which  
 gas flows both to, and from, a patient.  
 A replaceable moistening element (5)  
 has a plurality of hollow fibres (7)  
 which are impervious to liquid water  
 but pervious to water vapour. One of  
 the inner and outer peripheral surfaces  
 of the hollow fibres (7) is exposed to  
 water whilst the other of the inner and  
 outer peripheral surfaces contacts  
 inhalation gas to moisten it and  
 possibly warm it. Thus, a patient can  
 be provided, by means of the  
 connection piece, with warmed and  
 moistened gas, without the respiratory  
 apparatus having to include a separate  
 moistening device.

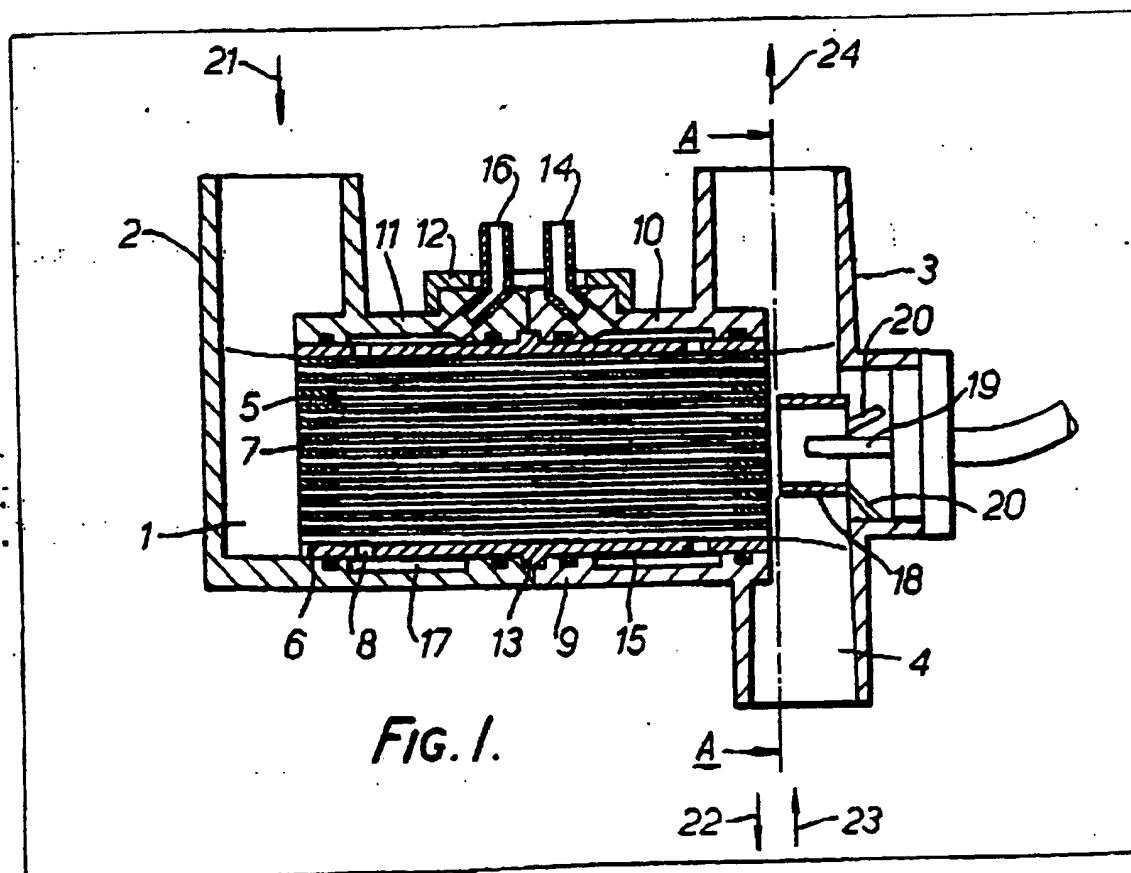


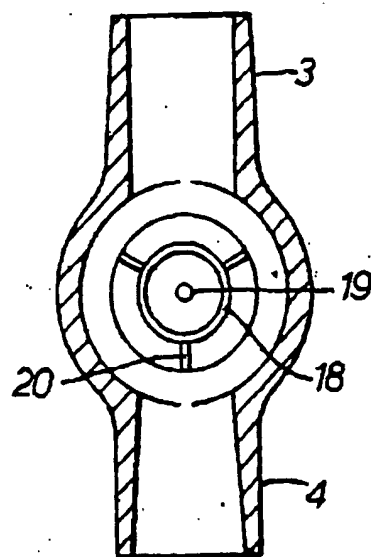
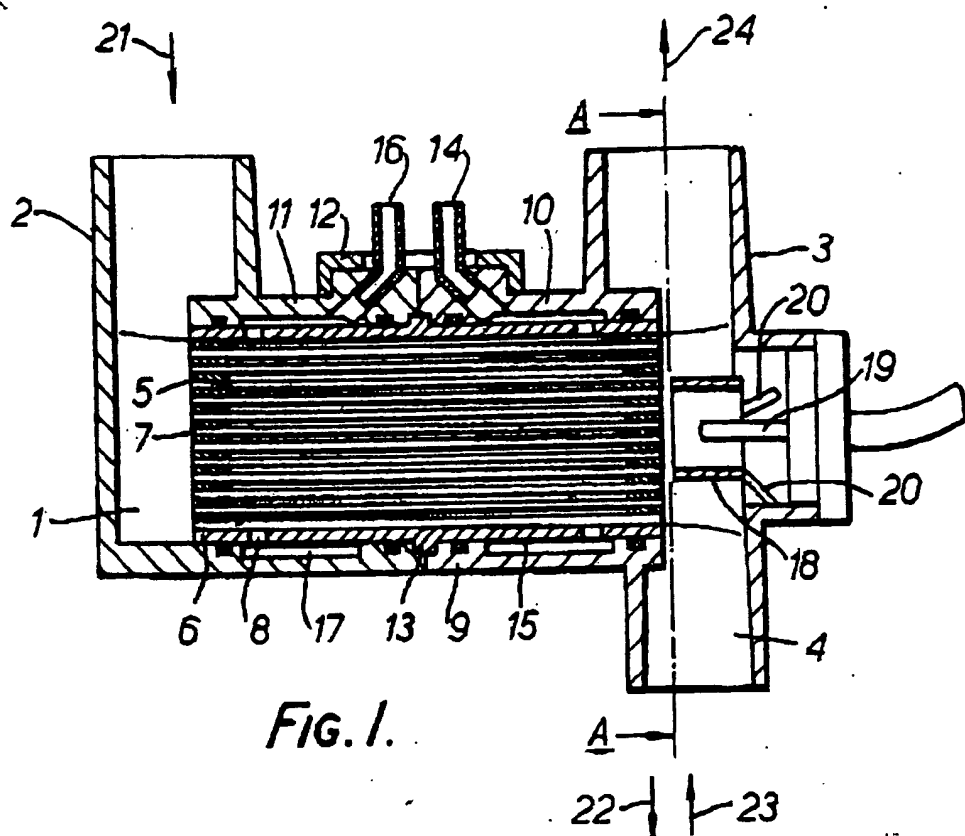
Fig. 1.

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# SPECIFICATION

## Connection piece for respiratory apparatus

This invention relates to a connection piece for a respiratory apparatus.

A patient is connected to the ventilator or respiratory apparatus by an inhalation line and an exhalation line. The inhalation line, as the respiratory gas supply line, branches out in a connection piece formed as a Y-piece into a first branch directly to the patient and into a second branch via a control valve to the exhalation valve or, in the case of circulatory apparatus, back into the respiratory circuit. When the control valve is closed the entire volume of respiratory gas passes via the first branch to the patient; when the control valve is open it passes to the exhalation valve or back into the circuit via the second branch, together with the exhaled gas of the patient, which returns via the first branch. Thus, the exhaled air mixes in the Y-piece with the circulated respiratory gas flow. The respiratory phases, respiratory rate and the inhalation phase/exhalation phase ratio are controlled by the opening and closing of the control valve.

The Y-piece is an essential, indispensable component in the respiratory air conduit.

For the patient's comfort it is necessary for the respiratory air to have adequate relative moisture. Too little moisture would lead to the air passages of the patient drying out. The respiratory gas systems therefore contain respiratory air moisteners.

Known respiratory air moisteners, as disclosed for example in German Patent Specification P26 17 985, contain hollow fibres conducting the respiratory gas and arranged axially in parallel as a bundle in a housing fitted by means of connections into the respiratory air conduit. The walls of the hollow fibres consist of foils which are impervious to water, but pervious to water vapour. The hollow fibres are fixed securely together at the front ends and are also fixed securely inside the housing by means of a sealing compound. Inside the bundle of hollow fibres perforated water inlet and water outlet pipes are also fixed in parallel with the hollow fibres in a sealing compound around ends of the fibres. The inflowing water flows around the hollow fibres. The water then passes through the walls of the hollow fibres into the hollow fibres in vapour form and thus moistens the respiratory gas which is conducted therethrough. Fitting the respiratory air moistener into the respiratory air conduit, above all as is necessary in the zone before the patient, results in a cumbersome arrangement.

According to the present invention there is provided a connection piece, suitable for use in a respiratory apparatus, the connection piece comprising: a housing having a first port for inhalation gas; a second port for exhalation gas; and a third port through which, in use, gas flows to and from a patient; and a replaceable moistening element comprising a plurality of hollow fibres which are impervious to liquid water but pervious

to water vapour and which are arranged so that the inner peripheral surfaces or the outer peripheral surfaces of the hollow fibres, in use, contact water whilst the outer peripheral surface of the inner peripheral surfaces respectively contact inhalation gas flowing from the first port to the third port.

Preferably, the replaceable moistening element is arranged so that, in use, inhalation gas contacts the outer peripheral surfaces of the hollow fibres, and preferably the housing includes inlet and outlet ducts for water.

Advantageously, the housing comprises a first housing part provided with the first port and with the inlet duct or the outlet duct, and a second housing part provided with the second and third ports and with the outlet duct or the inlet duct respectively, the replaceable moistening element being disposed in both the first and second housing parts.

In a connection piece according to the present invention, two components are combined in one, whereas previously these two essential structural elements were arranged in a very bulky manner next to each other. This makes it easier for the connection piece to be fitted into the respiratory system and in any case there is also one less coupling point. This is of great importance for the safety of the patients to be supplied with air. The subsequent fitting of respiratory air moisteners into existing respirators is substantially easier because it is merely necessary to exchange the existing connection piece. There is less heat radiation to be controlled for the moistening of the respiratory gas.

The housing comprising two housing parts should enable the replaceable moistening element to be easily exchanged.

A heat sensor can be disposed immediately next to an outlet of the hollow fibres of the moistening element and the temperature may be controlled without external action.

Connection pieces of the type to which the present invention relates are sometimes known as "Y pieces", even if the connection piece is not strictly Y-shaped. The first and second ports can be considered as the upper limbs of the "Y", whilst the third port provides the stem at the base of the "Y".

For a better understanding of the present invention and to show more clearly how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawing in which:

Figure 1 shows a connection piece with an integral replaceable moistening element in longitudinal section; and  
Figure 2 shows a section along the line A—A of Figure 1.

In the standard connection piece, the inhalation line, as the respiratory gas supply line, branches out into a first branch connected to a patient and into a second branch to an exhalation valve or in the case of apparatus with a closed circulatory gas flow back into the respiratory circuit. At the

branching point the exhalation air in the exhalation phase may then mix with respiratory gas possibly flowing from the inhalation gas inlet.

- 5 A connection piece according to the present invention is shown in the drawing and it has a housing 9, comprising a first housing part or component 11 and a second housing part or component 10. A first port 2 formed as an externally tapered socket for connection to an inhalation hose of the patient circuit of an apparatus is provided in the first housing part 11. A second port 3 also formed as an externally tapered socket for connection to an exhalation hose and a third port 4 formed as an internally tapered socket are provided in the second housing part 10.

- 20 An exchangeable or replaceable moistening element 5 comprises an outer pipe or casing 6 and a plurality of hollow fibres 7 extending through the space within the casing 8. The hollow fibres 8 are impervious to water but pervious to water vapour. The outer pipe 6 has holes or openings 8 to admit the water serving for humidification into that space. The element 5 is disposed in both housing parts 11 and 10. The first housing part 11 and the second housing part 10 of the housing 9 are held together by a collar 12. When an element 5 is to be changed, the collar 12 is removed; the housing parts 10 and 11 may then be removed from the element 5. The new element 5 is pushed into one housing part 10 or 11 until it touches a recess 13 in that one housing part 10 or 11. Then the other housing part 11 or 10 respectively can be placed over the other end of the element 5 and the housing 9 is then again held together by the collar 12.

- 40 In order to supply water to the replaceable moistening element 5, the second housing part 10 has an inlet duct 14 which opens into an annular second chamber or tapping 15 and the first housing part 11 has an outlet duct 16 which opens into an annular first chamber or tapping 17. The first and second chambers 15 and 17 communicate with one another via the openings 8 and the space in the casing 6 around the hollowing fibres 7.

- 50 To moisten the respiratory gas which is supplied through the first port 2 as indicated by an arrow 21 and then conducted to the patient through the hollow fibres 7 and the third port 4 as indicated by an arrow 22, heated water passes via the inlet duct 14 into the housing 9 and from there, via the second annular chamber 15 and holes 8 into the space around the bundle of hollow fibres 7 in order to flow around these. Some water penetrates through the walls of the hollow fibres as water vapour and is absorbed by the respiratory gas. The remaining water then leaves the housing 9 again via the first annular chamber 17 and the outlet duct 16.

- 80 An open pipe section 18 is disposed at an outlet of the hollow fibres 7 at the branching point to the second port 3 and the third port 4. In the pipe section 18, a heat sensor 19 which determines the temperature of the respiratory gas

issuing from the hollow fibres 7 is disposed. The pipe section 18 is secured to the housing 9 via supports 20 so as not to hinder the flow of respiratory gas. Exhaled gas air flows in the direction indicated by an arrow 23 through the third port 4 and then out again from the connection piece in the direction indicated by an arrow 24.

#### CLAIMS

- 75 1. A connection piece, suitable for use in a respiratory apparatus, the connection piece comprising: a housing having a first port for inhalation gas; a second port for exhalation gas; and a third port through which, in use, gas flows to and from a patient; and a replaceable moistening element comprising a plurality of hollow fibres which are impervious to liquid water but pervious to water vapour and which are arranged so that the inner peripheral surfaces or the outer peripheral surfaces of the hollow fibres, in use, contact water whilst the outer peripheral surfaces or the inner peripheral surfaces respectively contact inhalation gas flowing from the first port to the third port.
- 80 2. A connection piece as claimed in claim 1, wherein the replaceable moistening element is arranged so that, in use, inhalation gas contacts the inner peripheral surfaces of the hollow fibres and water contacts the outer peripheral surfaces of the hollow fibres, and wherein the housing includes inlet and outlet ducts for water.
- 85 3. A connection piece as claimed in claim 2, wherein the housing comprises a first housing part provided with the first port and with the inlet duct or the outlet duct, and a second housing part provided with the second and third ports and with the outlet duct or the inlet duct respectively; the replaceable moistening element being disposed in both the first and second housing parts.
- 90 4. A connection piece as claimed in claim 3, wherein the first and second housing parts are held together by a removable collar.
- 95 5. A connection piece as claimed in claim 3 or 4, wherein a first chamber is defined between the first housing part and the replaceable element, which chamber communicates with the inlet duct or the outlet duct and via one or more opening in a casing of the replaceable element with a space containing the hollow fibres, and wherein a second chamber is defined between the second housing part and the replaceable element, which second chamber communicates with the outlet duct or the inlet duct respectively and via one or more opening in said casing with said space in the replaceable element.
- 100 6. A connection piece as claimed in any preceding claim, in which the first, second and third ports each comprise a tapered socket.
- 105 7. A connection piece as claimed in any preceding claim, in which the second and third ports are in direction communication with one another.
- 110 8. A connection piece as claimed in claim 7, which includes a heat sensor disposed between

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the second port and the third port.

9. A connection piece as claimed in claim 8, in which the heat sensor is disposed adjacent outlets of the hollow fibres.

5 10. A connection piece as claimed in claim 8 or 9, in which the heat sensor is disposed in a pipe section secured to the housing by supports.

10 11. A connection piece as claimed in claim 10 when appendant to claim 3, in which the pipe section with the heat sensor is disposed in, and secured to, the second housing part.

12. A connection piece substantially as hereinbefore described with reference to, and as shown in, the accompanying drawing.